BEZEL INTERFACE FOR SMALL COMPUTING DEVICES

Technical Field

The present invention relates to an interface for electronic devices, and more specifically to a bezel interface for small
5   computing devices.

Background of the Invention

As technology advancements continue to miniaturize electronic circuits, portable electronic devices are quickly becoming capable of more and more computationally powerful
10   operations. Many complex program applications, once only executed on large desktop computers, can now be found running on modern "wearable" computer devices. For instance, modern personal digital assistants (PDAs), cellular phones, and smart watches may include a text and e-mail editor, a database program,
15   and an Internet browser.

One complicating factor in executing complex programs on such small computer devices is the lack of physical space available for a practical user interface compatible with complex program applications. Wearable computers often have a small
20   amount of surface area on which to provide a display screen and user input hardware. Because of this spatial constraint, small electronic devices tend to miniaturize input hardware, such as push buttons, knobs, and joysticks, so that less surface area is taken up by input elements. Miniaturizing input hardware,
25   however, often reduces their handiness and makes portable computing devices awkward and difficult to use.

Summary of the Invention

In accordance with the present invention, the above and other problems are solved by providing a user with a relatively large bezel surface for interfacing with a small computing device. The bezel interface is generally easier to handle and manipulate than conventional interfaces for small computing devices. In addition, the bezel is advantageously positioned along the perimeter of the device such that a majority of the device face is left available for displaying information in a display screen.

Thus, the present invention generally involves a user interface for a small computing device. The user interface includes a display screen for displaying user data. A bezel encircles the display screen and is movable relative to the display screen. Additionally, a cursor displayed within the display screen is responsive to bezel movement.

Another aspect of the present invention is a method of interfacing user input to a small computing device. When implemented as a method, the present invention includes the acts of displaying a cursor on a display screen; receiving a movement signal indicating movement of a bezel relative to the display screen, wherein the bezel encircles the display screen; and positioning the cursor on the display screen in response to the received movement signal.

The invention may also be implemented as a portable Internet device. Such a device includes a display screen for displaying Internet data. A bezel encircling the display screen is movable relative to the display screen. The device also includes at least one movement sensor configured to provide a movement signal when movement of the bezel occurs.

These and various other features as well as advantages, which characterize the present invention, will be apparent from a reading of the following detailed description and a review of the associated drawings.

Brief Description of the Drawings

Fig. 1 shows an exemplary smart watch device embodying the present invention.

Fig. 2 shows the major electrical components of a small computing device employing the present invention.

Fig. 3 shows one embodiment of the bezel interface assembly as contemplated by the present invention.

Fig. 4 shows a cross-sectional view of the smart watch of **Fig. 3** along section line **4-4**.

Fig. 5 shows an operational flow diagram of the bezel interface as contemplated by the present invention.

Detailed Description of the Invention

It is contemplated that the user interface of the present invention is employed to control small computing devices executing complex program applications therein, as well as to manipulate and enter data in the applications. Such small computing devices include personal digital assistants (PDAs), smart watches, mobile telephones, and the like. The present invention and its various embodiments are described in detail below with reference to the figures. When referring to the figures, like structures and elements shown throughout are indicated with like reference numerals.

In **Fig. 1**, an exemplary smart watch **102** embodying the present invention is shown. The smart watch **102** includes a device housing **104** containing the various components of the device. The device housing **104** is preferably made from a durable material, such as a metallic alloy or a hard plastic, which is capable of withstanding the rougher treatment associated with portable devices. A strap **106** is coupled with the housing **104** to

hold the smart watch **102** close to the user. The strap **106** may be
made from metal, plastic, leather, or other suitable material.

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    The smart watch **102** includes one or more input buttons **108**
mounted on the device housing **104**. The input buttons **108** provide
activation signals to the smart watch **102** which are responsive to
user interaction. For example, an input button **108** may be used
to turn on and off a device backlight (not shown), change modes
of operation, or start and stop a timer. Thus, the input buttons
108 enable a user to control the smart watch **102** by selecting
different tasks during different operating stages of the device.
Various types of input elements may be employed by the present
invention, including, but not limited to, pull/push button
switches, rocker switches, and touch sensitive elements.

    The smart watch **102** may also include a speaker **110** and a
microphone **112**. The speaker **110** can be used to play recorded
music, provide auditory alarms, and produce other sound output.
The microphone **112** can be used to detect sound for recording,
pick-up voice commands, and carry out telephone communications.

    Additional hardware may be coupled to the smart watch **102**
through a connector **114**. Such peripheral hardware may include
digital cameras, mass storage devices, network adapters,
printers, and scanners. Data transfer between the smart watch
102 and peripheral hardware may be conducted through serial or
parallel data transfer protocols. In addition, a communication
port **116** may be used to carry out wireless communications with
other electrical devices. Various communication protocols may be
supported by the communication port **116**, including Hyper Text
Transfer Protocol (HTTP), Post Office Protocol (POP), Time
Division Multiple Access (TDMA), Code Division Multiple Access
(CDMA), and Wireless Application Protocol (WAP). It should be
noted that the protocols listed above are provided as examples
only; it is contemplated that many other protocols known by those

skilled in the art may be supported by the smart watch **102**. In one embodiment of the present invention, the smart watch **102** is part of a wireless piconet, such as a BLUETOOTH (TM) WAP. BLUETOOTH is a Trademark owned by Telefonaktiebolaget LM

5   Ericsson.

A display screen **118** on the smart watch **102** is used to display information to the user. The display screen **118** is preferably a low power, high-resolution display, such as a liquid crystal display (LCD), and may be a monochrome, gray scale, or

10 color display. Furthermore, the display screen **118** may be touch-sensitive, thereby providing activation signals to the smart watch **102** when the display screen **118** is contacted by the user. A stylus (not shown) or other pointing device can be used in conjunction with a touch-sensitive display screen **118** to activate

15 a small region of the display.

In accordance with an embodiment of the present invention, a bezel **120** encircling the display screen **118** provides a user interface for the smart watch **102**. As described in detail below, the bezel **120** is movable relative to the display screen **118** in

20 one or more axes. For example, the bezel **120** can be rotated clockwise and counterclockwise, pivoted about a central pivot point, and slid horizontally and vertically with respect to **Fig. 1**. Bezel movement, in turn, is converted to user input for controlling the smart watch **102** and entering data. Particularly,

25 the bezel **120** can be used to direct a cursor within the display screen **118**.

In **Fig. 1**, the display screen **118** is shown containing several exemplary cursors contemplated by the present invention. One such cursor is a pointing icon cursor **122** which moves around

30 the display screen **118** in response to bezel motion. For example, the pointing icon cursor **122** may move left across the display

screen **118** in response to the bezel **120** being nudged left,
pivoted left, or turned counterclockwise with respect to **Fig. 1**.
The rotation speed of the bezel **120** can be measured to provide
variable cursor acceleration. In addition, the pointing icon

5 cursor **122** can be activated to select text, check boxes, and menu
items, and other screen objects. Activation of the pointing icon
cursor **122** may be achieved by actuating the bezel **120** or an input
button **108**. Furthermore, the pointing icon cursor **122** may
support drag-and-drop operations when cursor activation is

10 sustained while the bezel **120** is moved. It is contemplated that
the pointing icon **122** may change in appearance to indicate an
action to be performed if the cursor **122** is activated.

The bezel **120** may also be used to control a highlighted
selection cursor **124** within a selection array **126**. The

15 highlighted selection cursor **124** is able to move left, right, up,
and down within the menu array **126** according to bezel movement.
For example, when the bezel **120** is rotated clockwise, the
highlighted selection cursor **124** moves right, and when the bezel
120 is rotated counterclockwise the cursor **124** moves left.

20 Similarly, a pivoting and/or sliding motion of the bezel **120** may
control the position of the highlighted selection cursor **124**.
The highlighted selection cursor **124** can operate to select or
enter application menus, text, checkboxes, radio buttons, and
other interface widgets.

25 Another cursor contemplated by an embodiment of the present
invention is a scroll bar cursor **128**. As the scroll bar cursor
128 moves along a scroll bar **130**, the display screen **118** is
scrolled in the direction of the cursor movement. Scroll bar
cursor movement is controlled by the bezel **120**. For example, the

30 scroll bar cursor **128** may be moved up and down along a scroll bar

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130 by rotating the bezel **120** clockwise and counterclockwise,
respectively. Similar cursor movement may be achieved by
pivoting or nudging the bezel **120** up and down with respect to
Fig. 1.

5   The bezel **120** may also be used in conjunction with a text
selection cursor **132** for entering alphanumeric text in the smart
watch **102**. For example, the bezel **120** may be rotated clockwise
and counterclockwise to scroll through a set of characters
displayed in the text selection cursor **132**. When the desired
10   character appears in the text selection cursor **132**, the user
activates the cursor **132** and the desired character is entered.
Activation of the text selection cursor **132** may be achieved by
actuating the bezel **120** or an input button **108**. In another
embodiment of the present invention, the text selection cursor
15   **132** and bezel **120** may operate in accordance with U.S. Patent No.
XX,XXX,XXX, titled "J-Key Inspection", U.S. Patent Application
Serial No. 09/652,330, and incorporated in its entirety herein by
reference.

It is contemplated that combinations of bezel movements, or
20   gestures, may be used to interact with the smart watch **102**. For
example, pivoting the bezel **120** left and then rotating the bezel
120 may cause the screen **118** to scroll vertically, while pivoting
the bezel **120** right and then rotating the bezel **120** may cause the
screen **118** to scroll horizontally. In a similar, manner bezel
25   gestures may be used to enter alphanumeric input.

The present invention provides the user with a relatively
large bezel surface for interfacing with a small computing
device. Therefore, the bezel interface is generally easier to
handle and manipulate than conventional interfaces for small
30   computing devices. In addition, the bezel is advantageously
positioned along the perimeter of the device such that a majority

of the device face is left available for displaying information in a display screen. Thus, the bezel interface of the present invention supplies a relatively large user input surface while sacrificing only a minimum amount of display screen room.

5   In one embodiment of the present invention, the bezel **120** includes ridges **134** to help the user grip the bezel **120**. Other types of surface treatments, such as protrusions and depressions on the bezel surface, are also contemplated. The bezel **120** may also include a rubber surface to further prevent finger slippage.

10   Other high friction materials placed on the bezel **120** are considered within the scope and spirit of the present invention.

       Yet another embodiment of the present invention may include bezel buttons **136** on the bezel surface. The bezel buttons **136** can be dynamically assignable to various tasks according the

15   current application executed by the smart watch **102**. Alternatively, the bezel buttons **136** may be assigned to specific tasks which stay constant regardless of the executed application. In one embodiment of the invention, the bezel **120** includes at least one touch sensor **138** responsive to finger contact. As

20   such, the user may slide a finger along the sensor **138** to "virtually" rotate the bezel **120** in the direction of the finger movement without actually moving the bezel **120**. Similarly, the smart watch **102** may be configured to interpret a brief finger tap on the touch sensor **138** as a virtual pivot or nudge of the bezel

25   **120**.

       In **Fig. 2**, the major electrical components of a computing device **201** employing the present invention are shown. The small computing device **201** includes a central processing unit (CPU) **202** which is primarily responsible for carrying out arithmetic,

30   logic, and control operations. The CPU **202** may include a floating-point unit (FPU) and/or a co-processor (not shown).

Additionally, the CPU **202** may be a general-purpose processor, a digital signal processor (DSP), or other state machine circuit.

A memory unit **204** for storage of data and program code is coupled with the CPU **202** through a system bus **205**. The memory

5   unit **204** may include a memory cache, random access memory (RAM), video RAM (VRAM), and read only memory (ROM). In addition, the memory unit **204** may encompass mass storage media, such as magnetic and optical memory media.

The CPU **202** also communicates with input/output (I/O) ports

10   **206** through the system bus **205**. The I/O ports **206** allow the CPU **202** to receive and transmit data from and to the outside environment. Thus, various input and output components of the computing device **201**, such as the display screen **118**, the input buttons **108**, and the bezel interface **120** are coupled to the I/O

15   ports **206** for transmitting and receiving data to and from the user, respectively. The CPU **202** may access the I/O ports **206** as either memory mapped I/O space or as separately mapped I/O space. In addition, the I/O ports **206** may be configured to support interrupt-driven CPU access.

20   According to one embodiment of the present invention, the I/O ports **206** are also coupled to a network **212**, such as the Internet. Preferably, communications over the network **212** is achieved over a wireless connection between the computing device **201** and a network server (not shown). For example, the computing

25   device **210** may use a transfer control protocol/Internet protocol (TCP/IP) to exchange data across the network **212**.

In **Fig. 3**, one embodiment of the bezel interface assembly as contemplated by the present invention is shown. The bezel **120** is substantially ring-shaped with an outer surface **134** and an inner

30   surface **303**. As discussed above, rotation of the bezel **120** about

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the display **118** may be used to control the smart watch **102**.
Thus, when the bezel **120** is turned clockwise or counterclockwise,
a rotation sensor **304** is configured to sense the magnitude and
direction of the bezel rotation. The rotating sensor then sends

5   a motion signal corresponding to the bezel motion to the CPU **202**
(see **Fig. 2**), which acts upon the bezel motion.

In one embodiment of the invention, the rotation sensor **304**
is a spring-loaded, single throw, double pole switch. The
rotation sensor **304** is activated when inwardly pointed bezel

10   teeth **302** along the inner surface **303** of the bezel **120** are
rotated past the sensor **304**. Thus, when the bezel **120** is rotated
counterclockwise, the bezel teeth **302** push the sensor throw **306**
upwardly to make contact with a first switch pole, and thereby
indicating counterclockwise rotation of the bezel **120**.

15   Conversely, when the bezel **120** is rotated clockwise, the bezel
teeth **302** push the switch throw **306** downwardly to make contact
with a second switch pole, thereby indicating a clockwise
rotation of the bezel **120**. Since the switch throw **306** is spring-
loaded, it returns to an off position each time a bezel tooth

20   passes. The magnitude of the bezel rotation is determined by the
number of times the rotation sensor **304** is switched on by the
bezel teeth **302**. In a further embodiment of the present
invention, the bezel **120** may be biased by one or more springs **312**
to return the bezel **120** to a non-rotated or rest position when no

25   external rotational force is applied.

It is contemplated that other means of sensing bezel
rotation movement may be utilized in the present invention. For
example, those skilled in the art will recognize that bezel
rotation may be sensed using an optical encoder assembly.

30   Specifically, an alternating pattern of reflective and non-
reflective colors may be added to the inner surface **303** of the

bezel **120**. Optical transmitters and receivers are used to
determine rotation direction and magnitude of the bezel **120** as
the color pattern is rotated. Alternatively, an encoder ring
having a plurality of slits may be used to pass and block light

5   from an optical transmitter to an optical receiver. It is
further contemplated that a magnetic strip with an alternating
pattern of north and south poles may be attached to the inner
surface **303** of the bezel **120**, and a pair of magnetic sensors are
used to sense bezel rotation. These and other configurations for

10 sensing bezel rotation movement, such as potentiometers, are
considered within the scope and spirit of the claimed invention.

In another embodiment of the present invention, pivot
sensors **308** mounted below the bezel **120** are used to sense bezel
pivot movement. For example, a left push button **310** is activated

15 when the bezel **120** is pivoted in a leftwardly direction about a
center point. The bezel **120** may also be biased by a spring to
return to a non-pivoted position when no external pivoting force
is applied. Bezel pivot motion detection is discussed in greater
detail below.

20 Referring to **Fig. 4**, a cross-sectional view of the smart
watch **102** of **Fig. 3** along section line **4-4** is shown. The bezel
120 is rotatably coupled to a bezel platform **402**, such that the
bezel platform **402** stays fixed in position when the bezel **120** is
rotated about the bezel platform **402**. The bezel platform **402** has

25 a substantially C-shaped profile and includes a sidewall **407**
coupled with an upper lip **404** and a lower lip **405**.

As mentioned earlier, the bezel **120** may be pivoted about a
center axis **406**, wherein the center axis **406** is normal to a
display surface **408** and passes through a center point **410** on the

30 display **118**. In this manner, the bezel **120** is pivotable about a
pivot point on the center axis **406** by applying downwardly

directed force on the bezel **120**. When such pivot force is applied, a contact pad **416** is pressed into a pivot sensor **308** and the pivot sensor is activated. In one embodiment of the present invention, the upper lip **404** and sidewall **407** form a spring,

5 thereby biasing the bezel **120** to a non-pivoted or rest position when no external pivoting force is applied to the bezel. Therefore, when the pivot force is removed, the platform spring returns the bezel **120** to the center position and the pivot sensor **308** becomes deactivated.

10 In yet another embodiment of the present invention, the bezel platform **402** is slideably coupled with a watch base **412** at the lower lip **405**. Side springs **414** bias the bezel **120** and bezel platform **402** to a center position when the bezel **120** is released or at rest. In this configuration, movement sensors **418** are

15 arranged to detect linear or planar motion of the bezel **120** and bezel platform **402**. For example, when the bezel **120** is nudged to the right with respect to **Fig. 4**, a micro push button switch **420** is pressed against the bezel platform **402**, thereby providing a movement signal to the smart watch **102**. When the linear external

20 force is removed, the side springs **414** return the bezel **120** to the center position, thus, deactivating the movement sensors **418**.

In **Fig. 5**, an operational flow diagram of the bezel interface as contemplated by the present invention is shown. Display operation **502** displays a cursor on the display screen

25 **118**. As mentioned earlier, the cursor may include a pointing icon cursor, a highlighted menu selection cursor, a scroll bar cursor, and a text selection cursor. Furthermore, the position of the cursor is responsive to movement of the bezel **120**.

During a receive operation **504**, a movement signal is

30 received from a bezel sensor. As discussed previously, the

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present invention may include one or more bezel sensors configured to indicate movement of the bezel **120** relative to the display screen **118**. For example, a rotation sensor provides a movement signal when the bezel **120** is rotated about a center axis

5   normal to the display surface and passing through a center point on the display surface. Furthermore, pivot sensors provide movement signals indicating pivot motion of the bezel **120** about a pivot point located on the center axis. Movement sensors may also be present to provide movement signals when the bezel **120** is

10 moved along a plane substantially parallel to the display surface. Movement sensors may also work together to sense a combination of movements such as rotation and pivoting, sliding and pivoting, or all three motions together.

A positioning operation **506** positions the cursor on the

15 display screen **118** to a new location in response to received movement signals. The movement signals are passed through I/O ports **206** (see **Fig. 2**) to the CPU **202**, wherein the CPU **202** processes the movement signals received. After the CPU **202** determines the type of movement undergone by the bezel **120**, the

20 CPU **202** redraws the cursor in the display screen **118** according to the movement of the bezel **120**.

Although the invention has been described and illustrated with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example, and that

25 numerous changes, combinations, and arrangements of techniques can be resorted to by those skilled in the art without departing from the spirit and scope of the invention as claimed below.